Explorations of Public Participation Approach to the Framing of Resilient Urbanism

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Abstract. Under the framework of developing resilient and livable cities, this study was aimed at engaging local communities to achieve the goal of public participation. Given the prevalence of smart mobile devices, an interactive app called "Citizen Probe" was designed to guide users to participate in building resilient and livable urban spaces by enabling users to report the condition of their living environment. The app collects feedback from users regarding the perceived condition of the urban environment, and this information is used to further develop an open online index system. The index system serves as a guide for the public to actively transform their city into a resilient and livable urban environment. The app was designed for the reporting of flood incidents with the objective of resilient disaster prevention, which can be achieved by enabling users to identify disaster conditions in order to develop a database for basic disaster information. The database can be used in the prevention and mitigation of disasters and to provide a foundation for developing indices for assessing the resilience and livability of urban areas. Three communities in Taichung, Taiwan, participated in the study. Residents of these communities were requested to use the app and identify local environmental conditions to obtain spatial data according to four stages in disaster response: assessment, readiness, response, and recovery. A volunteered geographic information database was developed to display maps for providing users with current reports of predisaster risk assessment, disaster response capacity, real-time disaster conditions, and overall disaster recovery. In addition, the database can be used as a useful tool for researchers to conduct GIS analyses and initiate related discussions. The interactive app raises public awareness on disaster prevention and makes disaster prevention a daily norm. Further discussion between the public and experts will be initiated to assist in policy management pertaining to the ongoing development of cities in addition to improving disaster prevention and response measures.

1. Introduction

This study examined a system that was developed to facilitate public participation in building urban resilience through the use of a digital platform and basic environmental data constructed from feedback from students and community residents through specially arranged educational courses. The collected environmental information can be used as a basis for further public participation and discussion. Recently, the concept of urban resilience has received increasing attention in the field of spatial planning. Discourse on urban resilience has included not only environmental and ecological resource management but also the structural effects on urban space governance, particularly in the context of disaster prevention (Dudley, 2010) [1]. In the field of spatial planning, the concept of urban resilience is mainly expressed in the institutional and implementation aspects of urban policies, particularly in city-wise adaptive strategies for addressing climate change. The present study used

information technology to facilitate public participation in resilient disaster prevention by enabling urban communities to collectively make proactive urban development decisions and create urban livability and resilience.

Manuel Castells (1989a) indicated that information technology has altered the material basis of society as well as the processes through which new spatial forms and meanings are created [2]. Such technologies are particularly effective in realizing the concept of volunteered geographic information (VGI), which can facilitate public participation in developing social organizations (Castells, 1989b) [3]. Given the prevalence of smart mobile devices, the present study was aimed at using an interactive mobile app to enable public participation in providing local environmental information to build resilient and livable urban environments. Public feedback was collected to construct a database of information on the perceived condition of urban cities, and an open index system was developed to guide the public in actively transforming their urban environment into a more livable environment. With the trend of public participation in urban development and the development of networked societies, identifying and solving problems pertaining to urban living environments is no longer the sole responsibility of governments and scholars in democratic societies. Therefore, encouraging public participation in issues pertaining to the public sphere and providing appropriate communication platforms have become critical tasks that must be faced in this new era. Through the use of mobile terminals (e.g., smart mobile devices), participatory sensing can be realized, which would change the nature of traditional communication modes, in which communication is generally limited to members within the same community, enable the public to provide immediate feedback on the condition of their neighborhood, thereby assisting in collecting data for resilient city indices though a bottom-up approach.

Castells (2000) noted this contemporary social trend 17 years ago by stressing that, after the emergence of networked societies with the advent of the information age, social governance would transition from a traditional vertical hierarchy into various forms of information flows and sharing [4]. The Internet enables users to share or comment on information, which indirectly affects how other users interpret information; this was unachievable in the traditional mode of governmental information transmission or media user experience. By using such an online community system, the present study asserted that the public could use their own smart mobile devices to provide environmental information. Through the use of mapping technologies, the feedback can be imported into a geographic information system (GIS) analytical framework for further analysis of regional problems or public participation.

2. Resilient disaster prevention

In recent years, the concept of resilience has received considerable attention in addressing natural disasters in urban areas. This concept implies that a city must be able to restore its living functions and order as soon as possible following a disaster. Disaster prevention requires improving forecast and monitoring technologies, managing all basic environmental data, detecting anomalies to minimize loss of life and property, and issuing warnings in advance. Therefore, applying information communication and Internet technologies to developing effective solutions has become a global trend in disaster prevention and rescue, particularly in moving away from the traditional top-down approach to disaster prevention governance. Thus, this study focused on discussing the use of the Internet in assisting various communities in participating in disaster prevention through a bottom-up approach.

Foster (2006) proposed a framework comprising four stages for assessing a city's resilience in disaster prevention: assessment, readiness, response, and recovery. A resilient city must be able to assess and prepare for potential disasters, respond to disasters appropriately, and immediately restore city-operation mechanisms to the normal level. The continuous cycle of these four stages enables a city to respond properly to all types of potential disaster [5].

To develop resilience, a city must change not only its disaster prevention and management strategies but also the residents' mindset and behavior. Thus, this study proposed the mobile app Citizen Probe to incorporate the collective feedback of online communities into a city's disaster management decision-making processes and to gather basic environmental data for analyzing disaster prevention capability. The data are gradually accumulated by repeating the three procedures of public

participation: identification (of disaster prevention locations), coconstruction (establishment of disaster prevention locations), and mutual assistance (shelter capacity).

3. Public participation in collecting and managing environment information

French philosophers Deleuze and Guattari (1988) explained the impact of living experience on urban structures and emphasized that an orderly urban system is constructed and organized through a dynamic bottom-up social relationship. This social power from the lower levels forms the foundation of urban structures, whereas a top-down planning order, although rational, cannot fully govern the voice and energy of the social collective [6]. British geographer Massey (1997) considered this as a process of place making. The form of a space cannot govern local cultures and the sense of a place is represented through the subjectivity and experience of human life (Massey, 1997; Pred, 1984; Tuan, 1977) [7]-[9]. Public participation serves as a mechanism for coproducing a sense of place. Sociologist Habermas (1989) indicated that the public sphere must involve public participation to shape society and politics, and he emphasized the importance of social communication platforms because communication ensures the preservation of modern values (e.g., social rationality, consensus, liberation, and solidarity), which can be used as a foundation for generating critical perspectives and ensuring social reconstruction [10]. Therefore, identifying the ideal method for building an appropriate decision-making platform through public participation is a major objective of the present study.

The integration of global positioning systems (GPSs) and the Internet with mobile devices enables users to have easy access to spatial information and to share information with the public. Thus, convenient access to posting and receiving information in addition to advancements in mobile device technologies have given rise to VGI apps. Previously, information on maps, traffic accidents, and disaster reporting has been provided by official sources, and information releases can be delayed and unlikely to contain local information. However, VGI transforms information typically released in a top-down manner, under authoritative structures, or by professionals, into information that can be continually accumulated and disseminated by the public through various methods, hence reducing the distinction between information providers and users (Goodchild, 2007) and rendering VGI as a potential resource for collecting official geographic information. American geographer Goodchild (2007) suggested that, when employing participatory-sensing technology, citizens effectively become sensors for their city by marking the geographic locations of incidents and providing relevant information [11]. For instance, a platform must allow the dynamic registration of geographic information to increase user willingness to participate and to maximize the platform's effectiveness. If the public can participate in disaster reporting by marking the location of a disaster via GPS and autonomously providing information of predisaster risk assessment, disaster damage, and postdisaster recovery, the collected information can be used for GIS analysis and enhance current developments in disaster prevention.

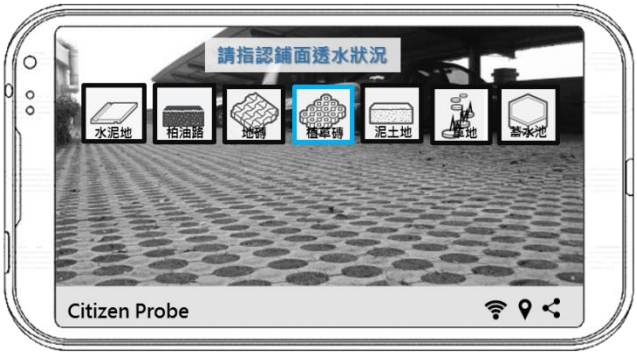

Figure 1: Reporting on surface water permeability on Citizen Probe

The present study applied the assessment framework for urban resilience proposed by Foster (2006) to the identification of flood incidents and developed a mobile app called Citizen Probe. The app enables users to participate in the following stages of disaster management and prevention: (1) Assessment: Photos can be taken and uploaded to report the surface water permeability of a living area (Fig. 1) and

imported in an online platform to determine the overall distribution of surface water permeability and thereby measure its capacity for coping with flood incidents. (2) Readiness: Potential disaster risks can be reported in advance to confirm whether an area is ready and well prepared for disaster response (e.g., ensuring drain cover blockages that may lead to poor drainage do not occur). (3) Response: Flood conditions can be immediately reported by users to inform others or rescue personnel of the actual flood height (Fig. 2) and enable them to understand overall flood conditions, thereby reducing water damage and increasing response efficiency. (4) Recovery: Flood water level decrease in flood areas can also be reported (Fig. 3) to calculate the total recovery time required for individual areas and to identify environmental problems that require further improvement actions.

Figure 2. Reporting flood height on Citizen Probe

Figure 3. Reporting flood recovery on Citizen Probe

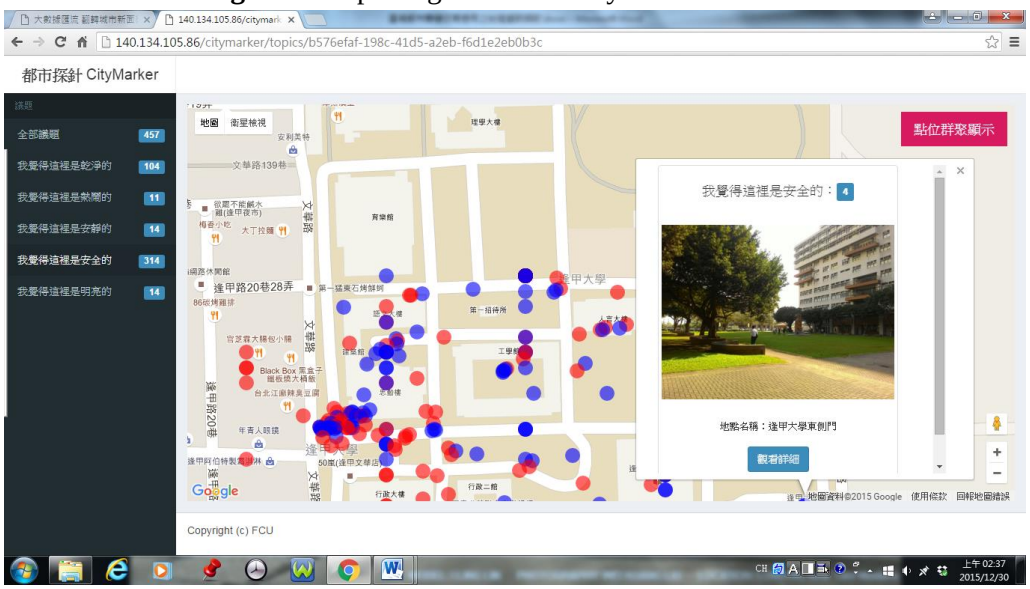

Figure 4. Spatial distribution of safe locations in the campus of Feng Chia University as reported by Citizen Probe users

To inform the public about the distribution, conditions, preparation, and response to flood incidents in their immediate area, this study constructed an open cloud database for users to connect to via

Facebook to upload photos taken with their mobile devices. The use of GPS enables the uploaded files to be integrated with geographic information on the flood location. The identified content is then accumulated to form a VGI database, which is visualized in the form of a map (see Fig. 4), providing immediate public access to current reporting on predisaster risk assessments, disaster response capacity, real-time disaster conditions, and overall disaster recovery. In addition, the VGI database can serve as a tool for researchers conducting GIS analyses and discussing disaster prevention and management. To display information, the online platform has a user-friendly interface that allows both the public and experts to discuss policies regarding disaster prevention developments in urban areas. The present study employed community volunteers to facilitate public participation and provided regular training on disaster prevention and mobile device usage.

4. Community participation

According to the following three criteria, three communities were selected from Taichung City to guide local residents in identifying and reporting local flood-related information to develop local disaster resilience. In the selection of participants and research regions, the following were considered: (1) past history of severe flood incidents, (2) convenience for observing flood levels, and (3) fully developed and comprehensive community operation. The selected communities were Wukuang (Wuri District) and Chungho (Nantun District). All locations are close to rivers and have a history of severe flooding due to heavy rainfall, and this continues to be a problem despite several attempts at river rectification. The community heads agreed to participate in the present study on a long-term basis. The present stage involves education courses designed to enroll students and community residents as volunteers to participate in experiments to test the Citizen Probe app (see Fig. 4). However, since the commencement of this study (August 2016), no severe flood has occurred in the selected communities; consequently, no data were collected to evaluate flood severity in the areas. Cooperation with these communities will be ongoing with regular disaster prevention drills to test Citizen Probe to ensure its effectiveness during disaster events.

5. Conclusion and future research directions

At present, this study is mainly focused on developing the Citizen Probe app and establishing a system for community participation. However, the following limitations were observed during the test drills and require further improvement: (1) the app cannot be operated with the mobile device in offline mode, (2) GPS accuracy is poor, and (3) lack of diverse presentation modes for displaying user-required information on the GIS maps. By continuously improving and adjusting the proposed app and system, this study suggests that a functional identification and interaction platform can be developed to achieve the goals of resilient disaster prevention. Moreover, Citizen Probe was applied only in the identification of flood incidents. It could also be used for other disasters or its user base could be expanded to determine its capacity for developing urban resilience.

In addition to the ongoing improvement of the app and system, this study suggests the following topics for future research: (1) integrating Internet-of-things technologies to strengthen the current disaster prevention and monitoring network, (2) establishing a sharing and cooperation system between public and private sectors, and (3) applying big data to disaster damage analysis. These efforts would improve the effectiveness of the current approach and transform the present feedback data from individual users into big data, which would have considerable analytical value and may serve as reference for future developments in resilient urbanism.

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